

CLAIMS

What is claimed is:

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1. An apparatus for analyzing a multi-component gas mixture, comprising:

10 (a) an array of four or more chemo/electro-active materials, each chemo/electro-active material exhibiting a different electrical response characteristic, upon exposure at a selected temperature to the gas mixture, than each of the other chemo/electro-active materials;

15 wherein the chemo/electro-active materials are selected from the group consisting of (i) at least one chemo/electro-active material that comprises M^1O_x , and (ii) at least three chemo/electro-active materials each of which comprises $M^1_aM^2_bO_x$;

20 wherein M^1 is selected from the group consisting of Al, Ce, Cr, Cu, Fe, Ga, Mn, Nb, Nd, Ni, Pr, Sb, Sn, Ta, Ti, W and Zn;

25 wherein M^2 is selected from the group consisting of Ga, La, Mn, Ni, Sn, Sr, Ti, W, Y, Zn;

wherein M^1 and M^2 are each different in $M^1_aM^2_bO_x$;

30 wherein a, b and c are each independently about 0.0005 to about 1; and wherein x is a number sufficient so that the oxygen present balances the charges of the other elements in the chemo/electro-active material; and

35 (b) means for determining the electrical response of each chemo/electro-active material upon exposure of the array to the gas mixture.

2. An apparatus according to Claim 1 that comprises an array of five or more chemo/electro-active materials wherein the chemo/electro-active materials are selected from the group consisting of at least four chemo/electro-active materials each of which comprises $M^1_aM^2_bO_x$.

3. An apparatus according to Claim 1 that comprises an array of six or more chemo/electro-active materials wherein the chemo/electro-active materials are selected from the group consisting of at least five chemo/electro-active materials each of which comprises $M^1_aM^2_bO_x$.

15 4. An apparatus for analyzing a multi-component gas mixture, comprising:

(a) an array of four or more chemo/electro-active materials, each chemo/electro-active material exhibiting a different electrical response characteristic, upon exposure at a selected temperature to the gas mixture, than each of the other chemo/electro-active materials;

25 wherein the chemo/electro-active materials are selected from the group consisting of (i) at least two chemo/electro-active materials each of which comprises M^1O_x , and (ii) at least two chemo/electro-active materials each of which comprises $M^1_aM^2_bO_x$;

30 wherein M^1 is selected from the group consisting of Al, Ce, Cr, Cu, Fe, Ga, Mn, Nb, Nd, Ni, Pr, Sb, Sn, Ta, Ti, W and Zn;

wherein M^2 is selected from the group consisting of Ga, La, Mn, Ni, Sn, Sr, Ti, W, Y, Zn;

35 wherein M^1 and M^2 are each different in $M^1_aM^2_bO_x$;

wherein a, b and c are each independently about 0.0005 to about 1; and

wherein x is a number sufficient so that the oxygen present balances the charges of the other elements in the chemo/electro-active material; and

5 (b) means for determining the electrical response of each chemo/electro-active material upon exposure of the array to the gas mixture.

10 5. An apparatus according to Claim 4 that comprises an array of five or more chemo/electro-active materials wherein the chemo/electro-active materials are selected from the group consisting of at least three chemo/electro-active materials each of which comprises $M^1_aM^2_bO_x$.

15 6. An apparatus according to Claim 4 that comprises an array of six or more chemo/electro-active materials wherein the chemo/electro-active materials are selected from the group consisting of at least four chemo/electro-active materials each of which comprises $M^1_aM^2_bO_x$.

7. An apparatus for analyzing a multi-component gas mixture, comprising:

25 (a) an array of four or more chemo/electro-active materials, each chemo/electro-active material exhibiting a different electrical response characteristic, upon exposure at a selected temperature to the gas mixture, than each of the other chemo/electro-active materials;

30 wherein the chemo/electro-active materials are selected from the group consisting of (i) at least one chemo/electro-active material that comprises M^1O_x , (ii) at least two chemo/electro-active materials each of which comprises $M^1_aM^2_bO_x$, and (iii) at least one chemo/electro-active material that comprises $M^1_aM^2_bM^3_cO_x$;

wherein M^1 is selected from the group consisting of Al, Ce, Cr, Cu, Fe, Ga, Mn, Nb, Nd, Ni, Pr, Sb, Sn, Ta, Ti, W and Zn;

5 wherein M^2 and M^3 are each independently selected from the group consisting of Ga, La, Mn, Ni, Sn, Sr, Ti, W, Y, Zn;

 wherein M^1 and M^2 are each different in $M^1_aM^2_bO_x$, and M^1 , M^2 and M^3 are each different in $M^1_aM^2_bM^3_cO_x$;

10 wherein a, b and c are each independently about 0.0005 to about 1; and

 wherein x is a number sufficient so that the oxygen present balances the charges of the other elements in the chemo/electro-active 15 material; and

(b) means for determining the electrical response of each chemo/electro-active material upon exposure of the array to the gas mixture.

20 8. An apparatus according to Claim 7 that comprises an array of five or more chemo/electro-active materials wherein the chemo/electro-active materials are selected from the group consisting of at least three chemo/electro-active materials each of which 25 comprises $M^1_aM^2_bO_x$.

 9. An apparatus according to Claim 7 that comprises an array of six or more chemo/electro-active materials wherein the chemo/electro-active materials 30 are selected from the group consisting of at least four chemo/electro-active materials each of which comprises $M^1_aM^2_bO_x$.

 10. An apparatus for analyzing a multi-component gas mixture, comprising:

(a) an array of four or more chemo/electro-active materials, each chemo/electro-active material exhibiting a different electrical response

characteristic, upon exposure at a selected temperature to the gas mixture, than each of the other chemo/electro-active materials;

5 wherein the chemo/electro-active materials are selected from the group consisting of (i) at least two chemo/electro-active material that comprises M^1O_x , (ii) at least one chemo/electro-active materials each of which comprises $M^1_aM^2_bO_x$, and (iii) at least one chemo/electro-active 10 material that comprises $M^1_aM^2_bM^3_cO_x$;

wherein M^1 is selected from the group consisting of Al, Ce, Cr, Cu, Fe, Ga, Mn, Nb, Nd, Ni, Pr, Sb, Sn, Ta, Ti, W and Zn;

15 wherein M^2 and M^3 are each independently selected from the group consisting of Ga, La, Mn, Ni, Sn, Sr, Ti, W, Y, Zn;

wherein M^1 and M^2 are each different in $M^1_aM^2_bO_x$, and M^1 , M^2 and M^3 are each different in $M^1_aM^2_bM^3_cO_x$;

20 wherein a, b and c are each independently about 0.0005 to about 1; and

25 wherein x is a number sufficient so that the oxygen present balances the charges of the other elements in the chemo/electro-active material; and

(b) means for determining the electrical response of each chemo/electro-active material upon exposure of the array to the gas mixture.

30 11. An apparatus according to Claim 10 that comprises an array of five or more chemo/electro-active materials wherein the chemo/electro-active materials are selected from the group consisting of at least two chemo/electro-active materials each of which comprises 35 $M^1_aM^2_bO_x$.

12. An apparatus according to Claim 10 that comprises an array of six or more chemo/electro-active

materials wherein the chemo/electro-active materials are selected from the group consisting of at least three chemo/electro-active materials each of which comprises $M^1_aM^2_bO_x$.

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13. An apparatus for analyzing a multi-component gas mixture, comprising:

(a) an array of four or more chemo/electro-active materials, each chemo/electro-active material exhibiting a different electrical response characteristic, upon exposure at a selected temperature to the gas mixture, than each of the other chemo/electro-active materials;

wherein the chemo/electro-active materials are selected from the group consisting of (i) at least three chemo/electro-active materials each of which comprises $M^1_aM^2_bO_x$, and (ii) at least one chemo/electro-active material that comprises $M^1_aM^2_bM^3_cO_x$;

20 wherein M^1 is selected from the group consisting of Al, Ce, Cr, Cu, Fe, Ga, Mn, Nb, Nd, Ni, Pr, Sb, Sn, Ta, Ti, W and Zn;

wherein M^2 and M^3 are each independently selected from the group consisting of Ga, La, Mn, Ni, Sn, Sr, Ti, W, Y, Zn;

25 wherein M^1 and M^2 are each different in $M^1_aM^2_bO_x$, and M^1 , M^2 and M^3 are each different in $M^1_aM^2_bM^3_cO_x$;

30 wherein a, b and c are each independently about 0.0005 to about 1; and

wherein x is a number sufficient so that the oxygen present balances the charges of the other elements in the chemo/electro-active material; and

35 (b) means for determining the electrical response of each chemo/electro-active material upon exposure of the array to the gas mixture.

14. An apparatus according to Claim 13 that comprises an array of five or more chemo/electro-active materials wherein the chemo/electro-active materials are selected from the group consisting of at least four chemo/electro-active materials each of which comprises $M^1_aM^2_bO_x$.

15. An apparatus according to Claim 13 that comprises an array of six or more chemo/electro-active materials wherein the chemo/electro-active materials are selected from the group consisting of at least five chemo/electro-active materials each of which comprises $M^1_aM^2_bO_x$.

15 16. An apparatus for analyzing a multi-component gas mixture, comprising:

(a) an array of four or more chemo/electro-active materials, each chemo/electro-active material exhibiting a different electrical response characteristic, upon exposure at a selected temperature to the gas mixture, than each of the other chemo/electro-active materials;

25 wherein the chemo/electro-active materials are selected from the group consisting of (i) the chemo/electro-active materials that comprise M^1O_x , (ii) the chemo/electro-active materials that comprise $M^1_aM^2_bO_x$, and (iii) the chemo/electro-active materials that comprise $M^1_aM^2_bM^3_cO_x$;

30 wherein M^1 is selected from the group consisting of Al, Ce, Cr, Cu, Fe, Ga, Mn, Nb, Nd, Ni, Pr, Sb, Sn, Ta, Ti, W and Zn;

wherein M^2 and M^3 are each independently selected from the group consisting of Ga, La, Mn, Ni, Sn, Sr, Ti, W, Y, Zn;

35 wherein M^1 and M^2 are each different in $M^1_aM^2_bO_x$, and M^1 , M^2 and M^3 are each different in $M^1_aM^2_bM^3_cO_x$;

wherein a, b and c are each independently about 0.0005 to about 1; and

5 wherein x is a number sufficient so that the oxygen present balances the charges of the other elements in the chemo/electro-active material; and

(b) a heater to continually maintain the chemo/electro-active materials at a minimum temperature of about 500°C or above;

10 (c) means for determining an individual electrical response of each chemo/electro-active material upon exposure of the array to the gas mixture; and

15 (d) means for obtaining, from no information about the gas mixture other than the individual electrical response of the chemo/electro-active materials, a determination related to the presence or concentration of a component in the gas mixture.

20 17. An apparatus according to Claim 1, 4, 7, 10, 13 and 16 wherein a chemo/electro-active material that comprises $M^1_aM^2_bO_x$ is selected from the group consisting of

25 a chemo/electro-active material that comprises $Al_aNi_bO_x$

a chemo/electro-active material that comprises $Cr_aMn_bO_x$,

a chemo/electro-active material that comprises $Cr_aY_bO_x$

30 a chemo/electro-active material that comprises $Cu_aGa_bO_x$,

a chemo/electro-active material that comprises $Cu_aLa_bO_x$

35 a chemo/electro-active material that comprises $Fe_aLa_bO_x$

5 a chemo/electro-active material that
comprises $Fe_aNi_bO_x$
 a chemo/electro-active material that
comprises $Fe_aTi_bO_x$
10 a chemo/electro-active material that
comprises $Mn_aTi_bO_x$
 a chemo/electro-active material that
comprises $Nd_aSr_bO_x$,
 a chemo/electro-active material that
comprises $Nb_aTi_bO_x$
15 a chemo/electro-active material that
comprises $Nb_aW_bO_x$
 a chemo/electro-active material that
comprises $Ni_aZn_bO_x$
20 a chemo/electro-active material that
comprises $Sb_aSn_bO_x$.
 a chemo/electro-active material that
comprises $Ta_aTi_bO_x$, and
 a chemo/electro-active material that
comprises $Ti_aZn_bO_x$.

18. An apparatus according to Claim 1, 4, 7,
10, 13 and 16 wherein a chemo/electro-active material
that comprises $M^1_aM^2_bM^3_cO_x$ is selected from the group
25 consisting of

30 a chemo/electro-active material that
comprises $Ga_aTi_bZn_cO_x$
 a chemo/electro-active material that
comprises $Nb_aTi_bZn_cO_x$

19. An apparatus for analyzing a multi-
component gas mixture, comprising:

35 (a) an array of three or more chemo/electro-
active materials, each chemo/electro-active material
exhibiting a different electrical response
characteristic, upon exposure at a selected temperature
to the gas mixture, than each of the other
chemo/electro-active materials;

wherein the chemo/electro-active materials are selected from the group consisting of (i) the chemo/electro-active materials that comprise M^1O_x , (ii) the chemo/electro-active materials that comprise $M^1_aM^2_bO_x$, and (iii) the chemo/electro-active materials that comprise $M^1_aM^2_bM^3_cO_x$;

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wherein M^1 is selected from the group consisting of Al, Ce, Cr, Cu, Fe, Ga, Mn, Nb, Nd, Ni, Pr, Sb, Sn, Ta, Ti, W and Zn;

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wherein M^2 and M^3 are each independently selected from the group consisting of Ga, La, Mn, Ni, Sn, Sr, Ti, W, Y, Zn;

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wherein M^1 and M^2 are each different in $M^1_aM^2_bO_x$, and M^1 , M^2 and M^3 are each different in $M^1_aM^2_bM^3_cO_x$;

wherein a, b and c are each independently about 0.0005 to about 1; and

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wherein x is a number sufficient so that the oxygen present balances the charges of the other elements in the chemo/electro-active material; and

25

(b) means for determining an individual electrical response of each chemo/electro-active material upon exposure of the array to the gas mixture;

wherein at least three chemo/electro-active materials comprise a group of three materials selected from one of the following groups

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the group of chemo/electro-active materials comprising, respectively, $Al_aNi_bO_x$, $Cr_aTi_bO_x$, and $Fe_aLa_bO_x$;

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the group of chemo/electro-active materials comprising, respectively, $Cr_aTi_bO_x$, $Fe_aLa_bO_x$, and $Fe_aNi_bO_x$;

the group of chemo/electro-active materials comprising, respectively, $Fe_aLa_bO_x$, $Fe_aNi_bO_x$, and $Ni_aZn_bO_x$;

5 the group of chemo/electro-active materials comprising, respectively, $Fe_aNi_bO_x$, $Ni_aZn_bO_x$, and $Sb_aSn_bO_x$;

10 the group of chemo/electro-active materials comprising, respectively, $Al_aNi_bO_x$, $Cr_aTi_bO_x$, and $Mn_aTi_bO_x$

the group of chemo/electro-active materials comprising, respectively, $Nb_aTi_bO_x$, $Ni_aZn_bO_x$, and $Sb_aSn_bO_x$

15 the group of chemo/electro-active materials comprising, respectively, $Ni_aZn_bO_x$, $Sb_aSn_bO_x$, and $Ta_aTi_bO_x$

20 the group of chemo/electro-active materials comprising, respectively, $Sb_aSn_bO_x$, $Ta_aTi_bO_x$, and $Ti_aZn_bO_x$

25 the group of chemo/electro-active materials comprising, respectively, $Cr_aMn_bO_x$, $Cr_aTi_bO_x$, and $Cr_aY_bO_x$

30 the group of chemo/electro-active materials comprising, respectively, $Cr_aTi_bO_x$, $Cr_aY_bO_x$, and $Cu_aGa_bO_x$

the group of chemo/electro-active materials comprising, respectively, $Cr_aY_bO_x$, $Cu_aGa_bO_x$, and $Cu_aLa_bO_x$

35 the group of chemo/electro-active materials comprising, respectively, $Cu_aGa_bO_x$, $Cu_aLa_bO_x$, and $Fe_aLa_bO_x$

the group of chemo/electro-active materials comprising, respectively, $\text{Cr}_a\text{Y}_b\text{O}_x$, $\text{Cu}_a\text{Ga}_b\text{O}_x$, and $\text{Cu}_a\text{La}_b\text{O}_x$

5 the group of chemo/electro-active materials comprising, respectively, $\text{Cu}_a\text{Ga}_b\text{O}_x$, $\text{Cu}_a\text{La}_b\text{O}_x$, and $\text{Fe}_a\text{Ti}_b\text{O}_x$

the group of chemo/electro-active materials comprising, respectively, $\text{Cr}_a\text{Mn}_b\text{O}_x$, $\text{Mn}_a\text{Ti}_b\text{O}_x$, and $\text{Nd}_a\text{Sr}_b\text{O}_x$

10 the group of chemo/electro-active materials comprising, respectively, $\text{Cr}_a\text{Ti}_b\text{O}_x$, $\text{Mn}_a\text{Ti}_b\text{O}_x$, and $\text{Nb}_a\text{Ti}_b\text{Zn}_c\text{O}_x$

15 the group of chemo/electro-active materials comprising, respectively, $\text{Mn}_a\text{Ti}_b\text{O}_x$, $\text{Nb}_a\text{Ti}_b\text{Zn}_c\text{O}_x$, and $\text{Ta}_a\text{Ti}_b\text{O}_x$

20 the group of chemo/electro-active materials comprising, respectively, $\text{Nb}_a\text{Ti}_b\text{Zn}_c\text{O}_x$, $\text{Ta}_a\text{Ti}_b\text{O}_x$, and $\text{Ti}_a\text{Zn}_b\text{O}_x$

the group of chemo/electro-active materials comprising, respectively, $\text{Ga}_a\text{Ti}_b\text{Zn}_c\text{O}_x$, $\text{Nb}_a\text{Ti}_b\text{O}_x$, and $\text{Ni}_a\text{Zn}_b\text{O}_x$

25 the group of chemo/electro-active materials comprising, respectively, $\text{Nb}_a\text{Ti}_b\text{O}_x$, $\text{Ni}_a\text{Zn}_b\text{O}_x$, and SnO_2

30 the group of chemo/electro-active materials comprising, respectively, $\text{Ni}_a\text{Zn}_b\text{O}_x$, SnO_2 , and $\text{Ta}_a\text{Ti}_b\text{O}_x$

the group of chemo/electro-active materials comprising, respectively, SnO_2 , $\text{Ta}_a\text{Ti}_b\text{O}_x$, and $\text{Ti}_a\text{Zn}_b\text{O}_x$

35 the group of chemo/electro-active materials comprising, respectively, $\text{Ta}_a\text{Ti}_b\text{O}_x$, $\text{Ti}_a\text{Zn}_b\text{O}_x$, and ZnO

the group of chemo/electro-active materials comprising, respectively, $Al_aNi_bO_x$, $Cr_aMn_bO_x$, and CuO

5 the group of chemo/electro-active materials comprising, respectively, $Cr_aMn_bO_x$, CuO , and $Nd_aSr_bO_x$

the group of chemo/electro-active materials comprising, respectively, CuO , $Nd_aSr_bO_x$, and Pr_6O_{11}

10 the group of chemo/electro-active materials comprising, respectively, $Nd_aSr_bO_x$, Pr_6O_{11} , and WO_3

the group of chemo/electro-active materials comprising, respectively, $Cu_aLa_bO_x$, Fe_aTibO_x , and
15 $Ga_aTibZn_cO_x$;

the group of chemo/electro-active materials comprising, respectively, Fe_aTibO_x , $Ga_aTibZn_cO_x$, and
Nb_aW_bO_x;

20 wherein a, b, c and x are as set forth above.

20. An apparatus for analyzing a multi-component gas mixture, comprising:

25 (a) an array of four or more chemo/electro-active materials, each chemo/electro-active material exhibiting a different electrical response characteristic, upon exposure at a selected temperature to the gas mixture, than each of the other
30 chemo/electro-active materials;

wherein the chemo/electro-active materials are selected from the group consisting of (i) the chemo/electro-active materials that comprise M^1O_x ,
(ii) the chemo/electro-active materials that
35 comprise $M^1_aM^2_bO_x$, and (iii) the chemo/electro-active materials that comprise $M^1_aM^2_bM^3_cO_x$;

wherein M^1 is selected from the group consisting of Al, Ce, Cr, Cu, Fe, Ga, Mn, Nb, Nd, Ni, Pr, Sb, Sn, Ta, Ti, W and Zn;

5 wherein M^2 and M^3 are each independently selected from the group consisting of Ga, La, Mn, Ni, Sn, Sr, Ti, W, Y, Zn;

 wherein M^1 and M^2 are each different in $M^1_aM^2_bO_x$, and M^1 , M^2 and M^3 are each different in $M^1_aM^2_bM^3_cO_x$;

10 wherein a, b and c are each independently about 0.0005 to about 1; and

 wherein x is a number sufficient so that the oxygen present balances the charges of the other elements in the chemo/electro-active 15 material; and

(b) means for determining an individual electrical response of each chemo/electro-active material upon exposure of the array to the gas mixture;

20 wherein at least four chemo/electro-active materials comprise a group of four materials selected from one of the following groups

25 the group of chemo/electro-active materials comprising, respectively, $Ga_aTi_bZn_cO_x$, $Nb_aTi_bO_x$, $Ni_aZn_bO_x$, and SnO_2

the group of chemo/electro-active materials comprising, respectively, $Nb_aTi_bO_x$, $Ni_aZn_bO_x$, $Sb_aSn_bO_x$, and ZnO

30 the group of chemo/electro-active materials comprising, respectively, $Ni_aZn_bO_x$, $Sb_aSn_bO_x$, $Ta_aTi_bO_x$, and ZnO ; and

35 the group of chemo/electro-active materials comprising, respectively, $Sb_aSn_bO_x$, $Ta_aTi_bO_x$, $Ti_aZn_bO_x$, and ZnO ;

wherein a, b, c and x are as set forth above.

21. An apparatus for analyzing a multi-component gas mixture, comprising:

5 (a) an array of six or more chemo/electro-active materials, each chemo/electro-active material exhibiting a different electrical response characteristic, upon exposure at a selected temperature to the gas mixture, than each of the other
10 chemo/electro-active materials;

wherein the chemo/electro-active materials are selected from the group consisting of (i) the chemo/electro-active materials that comprise M^1O_x , (ii) the chemo/electro-active materials that comprise $M^1_aM^2_bO_x$, and (iii) the chemo/electro-active materials that comprise $M^1_aM^2_bM^3_cO_x$;

15 wherein M^1 is selected from the group consisting of Al, Ce, Cr, Cu, Fe, Ga, Mn, Nb, Nd, Ni, Pr, Sb, Sn, Ta, Ti, W and Zn;

20 wherein M^2 and M^3 are each independently selected from the group consisting of Ga, La, Mn, Ni, Sn, Sr, Ti, W, Y, Zn;

25 wherein M^1 and M^2 are each different in $M^1_aM^2_bO_x$, and M^1 , M^2 and M^3 are each different in $M^1_aM^2_bM^3_cO_x$;

wherein a, b and c are each independently about 0.0005 to about 1; and

30 wherein x is a number sufficient so that the oxygen present balances the charges of the other elements in the chemo/electro-active material; and

35 (b) means for determining an individual electrical response of each chemo/electro-active material upon exposure of the array to the gas mixture;

wherein at least six chemo/electro-active materials comprise a group of four materials selected from one of the following groups

the group of chemo/electro-active materials comprising, respectively, $\text{Cr}_a\text{Mn}_b\text{O}_x$, $\text{Mn}_a\text{Ti}_b\text{O}_x$, $\text{Nd}_a\text{Sr}_b\text{O}_x$, $\text{Nb}_a\text{Ti}_b\text{Zn}_c\text{O}_x$, Pr_6O_{11} , and $\text{Ti}_a\text{Zn}_b\text{O}_x$

5 the group of chemo/electro-active materials comprising, respectively, $\text{Al}_a\text{Ni}_b\text{O}_x$, $\text{Cr}_a\text{Ti}_b\text{O}_x$, $\text{Fe}_a\text{La}_b\text{O}_x$, $\text{Fe}_a\text{Ni}_b\text{O}_x$, $\text{Ni}_a\text{Zn}_b\text{O}_x$, and $\text{Sb}_a\text{Sn}_b\text{O}_x$

10 the group of chemo/electro-active materials comprising, respectively, $\text{Al}_a\text{Ni}_b\text{O}_x$, $\text{Cr}_a\text{Ti}_b\text{O}_x$, $\text{Mn}_a\text{Ti}_b\text{O}_x$, $\text{Nb}_a\text{Ti}_b\text{Zn}_c\text{O}_x$, $\text{Ta}_a\text{Ti}_b\text{O}_x$, and $\text{Ti}_a\text{Zn}_b\text{O}_x$

15 the group of chemo/electro-active materials comprising, respectively, $\text{Ga}_a\text{Ti}_b\text{Zn}_c\text{O}_x$, $\text{Nb}_a\text{Ti}_b\text{O}_x$, $\text{Ni}_a\text{Zn}_b\text{O}_x$, $\text{Sb}_a\text{Sn}_b\text{O}_x$, $\text{Ta}_a\text{Ti}_b\text{O}_x$, and $\text{Ti}_a\text{Zn}_b\text{O}_x$

20 the group of chemo/electro-active materials comprising, respectively, $\text{Ga}_a\text{Ti}_b\text{Zn}_c\text{O}_x$, $\text{Nb}_a\text{Ti}_b\text{O}_x$, $\text{Ni}_a\text{Zn}_b\text{O}_x$, SnO_2 , $\text{Ta}_a\text{Ti}_b\text{O}_x$, and $\text{Ti}_a\text{Zn}_b\text{O}_x$

25 the group of chemo/electro-active materials comprising, respectively, $\text{Nb}_a\text{Ti}_b\text{O}_x$, $\text{Ni}_a\text{Zn}_b\text{O}_x$, $\text{Sb}_a\text{Sn}_b\text{O}_x$, $\text{Ta}_a\text{Ti}_b\text{O}_x$, $\text{Ti}_a\text{Zn}_b\text{O}_x$, and ZnO

30 the group of chemo/electro-active materials comprising, respectively, $\text{Cr}_a\text{Mn}_b\text{O}_x$, $\text{Cr}_a\text{Ti}_b\text{O}_x$, $\text{Cr}_a\text{Y}_b\text{O}_x$, $\text{Cu}_a\text{Ga}_b\text{O}_x$, $\text{Cu}_a\text{La}_b\text{O}_x$, and $\text{Fe}_a\text{La}_b\text{O}_x$

35 the group of chemo/electro-active materials comprising, respectively, $\text{Al}_a\text{Ni}_b\text{O}_x$, $\text{Cr}_a\text{Mn}_b\text{O}_x$, CuO , $\text{Nd}_a\text{Sr}_b\text{O}_x$, Pr_6O_{11} , and WO_3

the group of chemo/electro-active materials comprising, respectively, $\text{Cr}_a\text{Y}_b\text{O}_x$, $\text{Cu}_a\text{Ga}_b\text{O}_x$, $\text{Cu}_a\text{La}_b\text{O}_x$, $\text{Fe}_a\text{Ti}_b\text{O}_x$, $\text{Ga}_a\text{Ti}_b\text{Zn}_c\text{O}_x$, and $\text{Nb}_a\text{W}_b\text{O}_x$; and

the group of chemo/electro-active materials comprising, respectively, $\text{Cr}_a\text{Mn}_b\text{O}_x$, $\text{Mn}_a\text{Ti}_b\text{O}_x$, $\text{Nd}_a\text{Sr}_b\text{O}_x$, $\text{Nb}_a\text{Ti}_b\text{Zn}_c\text{O}_x$, Pr_6O_{11} , and $\text{Ti}_a\text{Zn}_b\text{O}_x$;

5 wherein a, b, c and x are as set forth above.

22. An apparatus according to Claim 1, 4, 7, 10, 13, 16, 19, 20 and 21 wherein a chemo/electro-active material further comprises a frit additive.

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23. An apparatus according to Claim 1 that determines the presence or concentration of a nitrogen oxide in the multi-component gas mixture.

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24. An apparatus according to Claim 1 that determines the presence or concentration of a hydrocarbon in the multi-component gas mixture.

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25. An apparatus according to Claim 1 that determines the presence or concentration of a nitrogen oxide and a hydrocarbon in the multi-component gas mixture.

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26. An apparatus according to Claim 1 wherein the component gases in the gas mixture are not separated.

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27. An apparatus according to Claim 1 wherein the electrical responses of the chemo/electro-active materials are determined upon exposure to only the multi-component gas mixture.

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28. An apparatus according to Claim 1 further comprising means for calculating the concentration within the gas mixture of at least one individual gas component.

29. An apparatus according to Claim 1 wherein the multi-component gas mixture is emitted by a process, or is a product of a chemical reaction that is transmitted to a device, and wherein the apparatus 5 further comprises means for utilizing the electrical responses for controlling the process or operation of the device.

30. A vehicle for transportation comprising an 10 apparatus according to Claim 1.

31. Equipment for construction, maintenance or industrial operations comprising an apparatus according to Claim 1.

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32. An apparatus according to Claim 1 further comprising heating means for separately heating each chemo/electro-active material.

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33. An apparatus according to Claim 1 wherein each chemo/electro-active material is heated to the same temperature.

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34. An apparatus according to Claim 1 wherein one or more chemo/electro-active materials is heated to a different temperature than the other chemo/electro-active materials.

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35. An apparatus according to Claim 1 wherein the chemo/electro-active materials are on a substrate made from a material selected from the group consisting of silicon, silicon carbide, silicon nitride, and alumina with a resistive dopant.

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36. An apparatus according to Claim 1 wherein the gas mixture comprises an organo-phosphorus gas.

37. An apparatus according to Claim 1 which
may be held in the human hand.

38. An apparatus according to Claim 1 which is
5 located in the ventilation system of a building or car.